

Original claims 1-6 have also been amended in formal respects to improve the wording thereof. New claim 9 has been added to cover the feature recited in original claim 4 directed to the cap member and the O-ring. Original independent claims 7 and 8 have been rewritten as new claims 10 and 11-13, respectively, to correct informalities and improve the wording thereof. New claim 14-30 have been added to provide a fuller scope of coverage. A new abstract in compliance MPEP §608.01(b) has been substituted for the original abstract.

In view of the foregoing, applicant respectfully submits that the objection to the abstract has been overcome and should be withdrawn.

Attached hereto is a marked-up version of the changes made to the specification, abstract and claims by the current amendment. The attached pages i-vi are captioned **"VERSION WITH MARKINGS TO SHOW CHANGES MADE"**.

Applicant respectfully requests reconsideration of his application in light of the following discussion.

Brief Summary of the Invention

The present invention is directed to an ink jet head, an ink jet recording apparatus, and a method for removing dust from the ink jet head.

Fig. 7 shows a conventional ink jet head for an ink jet recording apparatus. Grooves 102 are formed in a piezo-ceramic plate 101 and are separated by side walls 103. One

end portion of each groove 102 extends up to an end surface of the piezo-ceramic plate 101. The other end portion of each of the grooves 102 does not extend up to the other end surface of the piezo-ceramic plate 101 and gradually decreases in depth. Electrodes 105 for applying drive voltages are disposed on surfaces of both side walls 103 of each groove 102. An ink chamber forming substrate 107 has an ink chamber 106 communicating with the end portion of each groove 102 having the decreased depth. The ink chamber forming substrate 107 is connected to the piezo-ceramic plate 101 on the side where the grooves 102 are opened. A passage forming member 109 for sealing one side of the ink chamber 106 and having an ink supply passage 108 for supplying ink to the ink chamber 106 is fixed to the ink chamber forming substrate 107. A nozzle plate 110 is joined to end surfaces of the piezo-ceramic plate 101 and the ink chamber forming substrate 107. Nozzle apertures 111 are formed in the nozzle plate 110 so as to face the respective grooves 102 in the nozzle plate 110. When ink is supplied to grooves 102 via the ink supply passage 10 and a predetermined driving electric field is applied to the side wall 103 of each groove 102 through electrodes 105, the side walls 103 are deformed to vary the capacity of the grooves 102 so that the ink can be discharged from the groove 102 through nozzle apertures 111.

A problem associated with the foregoing conventional ink jet head is that ink cannot be efficiently discharged

through the nozzle apertures 111 due to dust and/or bubbles (hereinafter "dust") in the ink. In an effort to resolve this problem, a filter 112 has been provided at the end of the ink supply passage 108 at the side of the ink chamber 106 in order to prevent dust and bubbles in the ink from entering the ink chamber 106. However, while the filter 112 prevents entry of dust and bubbles of a certain size, it does not completely prevent the entry of dust and bubbles. Additionally, while the use of a finely meshed filter would prevent the entry of dust to a large degree, such a filter disturbs the flow of ink.

The present invention overcomes the drawbacks of the conventional art. Figs. 1-5 show an embodiment of an ink jet head 10 according to the present invention embodied in the claims. The ink jet head 10 comprises a substrate 16 and partition walls 18 disposed on a main surface of the substrate 16 and spaced apart at a preselected interval to form channels 17 each for receiving ink and having a pair of deformable side walls. An ink chamber plate 21 is connected to the substrate 16 to define with the partition walls 18 an ink chamber 20 for supplying ink to the channels 17. Electrodes 19 are connected to the side walls of the channels 17 and are driven by a voltage signal to deform the side walls to vary the volume in the channels 17 to thereby eject ink from the channels 17. A nozzle plate 22 is connected to the substrate 16 and has nozzle openings 23 each disposed in communication with

respective ones of the channels 17 so that when the electrodes 19 are driven by a voltage signal ink is ejected from the channels 17 through the nozzle openings 23. A passage forming member 12 is connected to the substrate 16 and has an ink supply passage 26 disposed in communication with the ink chamber 20 for supplying ink contained in an ink storage device (not shown) to the ink chamber 20. The passage forming member 12 also has ink discharge passages 27 and 28 for discharging ink from the ink chamber 20.

By the foregoing construction, unwanted substances, such as dust particles and bubbles, contained in the ink disposed in the ink chamber and the channels of the ink jet head can be reliably removed from the ink chamber and the channels. For example, in an embodiment of a method for removing unwanted substances from ink in an ink jet head according to the present invention, the ink which contains unwanted substances and which is disposed in the ink chamber and channels of the ink jet head are first stirred to cause the unwanted substances to accumulate at one or more regions of the ink chamber and channels. The stirring step may be conducted, for example, by absorbing the ink which contains the unwanted substances through one or both of the discharge passages. The stirred ink accumulated at the one or more regions is then discharged through one or both of the discharge passages to thereby remove the unwanted substances from the ink. By this method, unwanted substances contained

in the ink disposed in the ink chamber and the channels of the ink jet head can be removed with high reliability to thereby achieve high quality printing and improved durability.

Traversal of Prior art Rejections

Rejection Under 35 U.S.C. §102(b)

Claims 1-4 and 6 were rejected under 35 U.S.C. §102(e) as being anticipated by Namekawa. Applicant respectfully traverses this rejection and submits that claims 1-4 and 6 recite subject matter which is not identically disclosed or described in Namekawa.

Amended independent claim 1 is directed to an ink jet head and requires a substrate, a plurality of partition walls disposed on a main surface of the substrate and spaced apart at a preselected interval to form a plurality of channels each for receiving ink, an ink chamber plate connected to the substrate to define with the partition walls an ink chamber for supplying ink to the channels, and a passage forming member connected to the substrate and having an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging ink from the ink chamber. No corresponding structural combination is disclosed or described by Namekawa.

Namekawa discloses a serial ink jet printer 50 (Figs. 1 and 4(A)-4(B)). The ink jet printer 50 has an ink

tank 51 and a print head 51. The ink tank 51 has ink storing chambers 55A-55C formed in a case body 55 and containing ink storing bags 60 each having an ink channel 60B. Ink feed ports 55YA-55YC for feeding ink to the print head 52 are formed at the bottom ends of the ink bag storing chambers 55A-55C. Ink absorbers 61A-61C are set in the ink feed portions 55YA-55YC, respectively. Ink discharged from the ink channels 60B of the ink storage bags 60 is impregnated and held by the ink absorbers 61A-61C to be fed to the print head 52.

Applicant respectfully submits that the structure of the ink jet head recited in amended independent claim 1 is patentably distinct from the structure of the serial ink jet printer 50 disclosed by Namekawa. More specifically, the ink jet printer 50 of Namekawa does not have a plurality of partition walls disposed on a main surface of a substrate and spaced apart at a preselected interval to form a plurality of channels each for receiving ink, and an ink chamber plate connected to the substrate to define with the partition walls an ink chamber for supplying ink to the channels, as required by amended independent claim 1. The ink jet printer 50 of Namekawa also fails to disclose or describe a passage forming member connected to the substrate and having an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging

ink from the ink chamber, as required by amended independent claim 1.

In the absence of the foregoing disclosure recited in amended independent claim 1, anticipation cannot be found. See, e.g., W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984) ("Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration"); Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746, 1748 (Fed. Cir. 1991) ("When more than one reference is required to establish unpatentability of the claimed invention anticipation under § 102 can not be found."); Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added) ("Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim").

Stated otherwise, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. This standard is clearly not satisfied by Namekawa for the reasons stated above. Furthermore, Namekawa does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Namekawa's serial ink jet printer to arrive at the claimed invention.

Claims 2-4 and 6 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from the reference at least in the same manner as claim 1.

In view of the foregoing, applicant respectfully requests that the rejection of claims 1-4 and 6 under 35 U.S.C. §102(e) as being anticipated by Namekawa be withdrawn.

Rejection Under 35 U.S.C. §103(a)

Claim 5 was rejected under 35 U.S.C. §103(a) as being unpatentable over Namekawa in view of Hirasawa. Applicant respectfully traverses this rejection and submit that the combined teachings of Namekawa and Hirasawa do not disclose or suggest the subject matter recited in amended claim 5.

Namekawa does not disclose or suggest the subject matter recited in amended independent claim 1 as set forth above for the rejection of claims 1-4 and 6 under 35 U.S.C. §102(e). Claim 5 depends on and contains all of the limitations of amended independent claim 1 and, therefore, distinguishes from the reference at least in the same manner as claim 1.

The Examiner cited the reference to Hirasawa for its disclosure of a filter 30 disposed between an ink supply passage 17 and an ink chamber 12 (Fig. 4). However, Hirasawa does not disclose or suggest the structural combination of the ink jet head recited in amended independent claim 1. Since

Hirasawa does not disclose or suggest the structure of the ink jet head recited in claim 1, it does not cure the deficiencies of Namekawa. Accordingly, one of ordinary skill in the art would not have been led to modify the references to attain the claimed subject matter.

In view of the foregoing, applicant respectfully requests that the rejection of claim 5 under 35 U.S.C. §103(a) as being unpatentable over Namekawa in view of Hirasawa be withdrawn.

Applicant respectfully submits that new claims 9-30 also patentably distinguish from the prior art of record.

New claim 9 depends on and contains all of the limitations of amended claim 4, which depends on amended independent claim 1, and, therefore, distinguishes from the references at least in the same manner as claims 1 and 4.

New independent claim 10 corresponds to original independent claim 7 and is directed to a method for removing unwanted substances including dust particles and bubbles from ink in an ink jet head. Claim 10 requires the step of providing an ink jet head comprised of an ink chamber having ink which contains unwanted substances, a plurality of channels disposed in communication with the ink chamber and having ink which contains unwanted substances, and a plurality of discharge passages for discharging ink which contains unwanted substances from the ink chamber and the channels. Claim 10 further requires the steps of stirring the ink which

contains unwanted substances in the ink chamber and the channels of the ink jet head to cause the unwanted substances to accumulate at one or more regions of the ink chamber and channels, and discharging the stirred ink accumulated at the one or more regions through at least one of the discharge passages to thereby remove the unwanted substances from the ink. No corresponding combination of steps are disclosed or suggested by the prior art of record. For example, Namekawa does not disclose or describe the specific stirring and discharging steps recited in independent claim 10.

New claims 11-13 correspond to the subject matter of original claim 8. Claims 11-13 and 14 depend on and contain all of the limitations of independent claim 10 and, therefore, distinguish from the references at least in the same manner as claim 10.

New independent claim 15 is directed to an ink jet head and requires a substrate having an ink chamber for storing ink and a plurality of channels disposed in communication with the ink chamber for receiving ink from the ink chamber, and a passage forming member connected to the substrate and having an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging ink from the ink chamber. No corresponding structural combination is disclosed or suggested by the prior art of record.

New claims 16-25 depend on and contain all of the limitations of independent claim 15 and, therefore, distinguish from the references at least in the same manner as claim 15.

New independent claim 26 is directed to a method for removing unwanted substances including dust particles and bubbles from ink in an ink jet head. Claim 26 requires the step of providing an ink jet head comprised of an ink chamber and a plurality of channels disposed in communication with the ink chamber to define a flow path extending between the ink chamber and the channels and having ink which contains unwanted substances, and a plurality of discharge passages disposed in communication with the flow path for discharging ink which contains unwanted substances from the flow path. Claim 26 also requires the steps of causing the ink which contains unwanted substances to accumulate at one or more regions of the flow path, and discharging the ink accumulated at the one or more regions of the flow path through at least one of the discharge passages to thereby remove the unwanted substances from the ink. Again, no corresponding combination of steps are disclosed or suggested by the prior art of record.

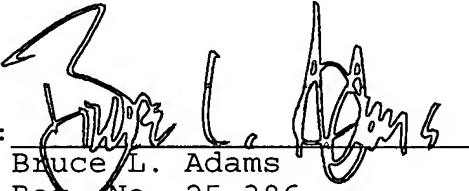
New claims 27-30 depend on and contain all of the limitations of independent claim 26 and, therefore, distinguish from the references at least in the same manner as claim 26.

In view of the foregoing amendments and discussion,
the application is now believed to be in condition for
allowance. Accordingly, favorable and reconsideration and
allowance of the claims are most respectfully requested.

Respectfully submitted,

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Attorney Name

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February 27, 2003

Date

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE ABSTRACT:

The original abstract has been replaced with the following new abstract:

An ink jet head has a substrate and partition walls disposed on a main surface of the substrate and spaced apart at a preselected interval to form channels. An ink chamber plate is connected to the substrate to define with the partition walls an ink chamber for supplying ink to the channels. A passage forming member has an ink supply passage disposed in communication with the ink chamber for supplying ink contained in an ink storage device to the ink chamber and at least one ink discharge passage for discharging ink from the ink chamber.

IN THE SPECIFICATION:

Paragraph beginning at line 3 of page 1 has been amended as follows:

The present invention relates to an ink jet head and an ink jet recording apparatus that prints by discharging ink droplets through nozzle apertures, and to a method for removing unwanted substances including dust particles and bubbles from the ink jet head.

Paragraph beginning at line 15 of page 3 has been amended as follows:

[The dust, etc., having passed] Dust which passes through the filter 112 is removed by a so-called cleaning operation in which the ink contained in the grooves 102 and the ink chamber 106 is absorbed through the nozzle apertures 111. This cleaning operation, however, cannot completely remove the dust. The head [with] from which the dust has not been removed must be disposed of.

Paragraph beginning at line 15 of page 7 has been amended as follows:

First, the structure of the head chip 11 will be described. As shown in Figs. 3A and 3B, a plurality of channels or grooves 17 are formed in parallel in a piezo-ceramic plate 16 of the head chip 11, and the grooves 17 are separated by side walls 18. One end portion of each groove 17 extends up to one end face of the piezo-ceramic plate 16, whereas the other end portion of each groove 17 does not extend up to the other end face of the piezo-ceramic plate 16 and gradually decreases in depth. The grooves 17 are formed in the piezo-ceramic plate 16 by a disc-shaped dice cutter or the like. The shallow portions of the grooves 17 are unnecessary, but they are inevitably formed due to the shape of the dice cutter.

Paragraph beginning at line 2 of page 10 has been amended as follows:

The passage forming member 12 now will be described. As shown in Figs. 4 and 5, in the substantially central area of the passage forming member 12 in the longitudinal direction, there is provided an ink supply passage 26 that constitutes a part of an ink passage, which connects an ink storage means (not illustrated) for storing ink in an ink tank or the like to the ink chamber 20. In the respective regions in proximity to both ends of the passage forming member 12 in the longitudinal direction thereof, there are provided ink discharge passages or communicating passages 27 and 28 that connect the ink chamber 20 to the outside so as to discharge the ink from the ink chamber 20 to the outside.

Paragraph beginning at line 20 of page 10 has been amended as follows:

On the other hand, according to this embodiment, a check valve 31 is provided in each of the communication passages 27 and 28 formed in the regions corresponding to both ends of the ink chamber 20 in the longitudinal direction. The check valve 31 permits only a flow from the ink chamber 20 to the outside so that the ink in the ink chamber 20 can be discharged to the outside through the communication passage 27 and 28 without being exposed to the air. Although described later in further detail, the [dust] unwanted substances

included in the ink in the ink chamber 20 and the grooves 17 is removed by absorbing the ink in the ink chamber 20 and the grooves 17 through at least one of the communication passages 27 and 28 when the ink jet head is manufactured, maintained, or the like. It should be noted that in this description the word ["dust" also means] "unwanted substances" includes, for example, dust particles and bubbles. [included in the ink in this description.]

IN THE CLAIMS:

Claims 1-6 have been amended as follows:

1. (Amended) An ink jet head[, which comprises] comprising: a substrate; a plurality of partition walls . disposed on a main surface of the substrate and spaced apart at a preselected interval to form a plurality of channels each for receiving ink; an ink chamber plate connected to the substrate to define with the partition walls [chambers being in communication with nozzle apertures and] an ink chamber for supplying ink to the channels; and [chambers, and which changes the capacity of the chambers to discharge ink contained in the chambers through the nozzle apertures, the ink jet head being characterized by] a passage forming member connected to the substrate and having an ink supply passage communicating the ink chamber for supplying ink contained in an ink storage device to the ink chamber and [constituting a part of a passage connecting an ink storage means storing ink

therein to the ink chamber, the passage forming member having] at least one [communicating] ink discharge passage for [capable of] discharging [the] ink from the ink chamber.

2. (Amended) An ink jet head according to [claim 1, characterized in that the communicating] claim 1; wherein the ink discharge passage extends along [is formed in each of regions in proximity to both ends of the ink chamber in] a longitudinal direction of the ink chamber. [thereof.]

3. (Amended) An ink jet head according to [claim 1, characterized in that the communicating passage has] claim 1; further comprising a check valve disposed in the ink discharge passage to permit the flow of ink [permitting only a flow] from the ink chamber in only one direction [to outside].

4. (Amended) An ink jet head according to [claim 1, characterized in that the communicating passage is sealed by securing] claim 1; further comprising sealing means for sealing the ink discharge passage to prevent the discharge of ink from the ink discharge passage. [a cap member to the passage forming member through an O-ring.]

5. (Amended) An ink jet head according to [claim 1, characterized in that] claim 1; further comprising a filter disposed [is provided] between the ink supply passage and the ink chamber[, and ink is supplied from the ink storage means

to the ink chamber through the filter] for filtering the ink supplied from the ink storage device to the ink chamber.

6. (Amended) An ink jet recording apparatus comprising: [having] an ink jet head according to claim 1[,]; and [characterized by] absorbing means [connected to the communicating passage, the absorbing means] for absorbing the ink in the ink chamber through the ink discharge [communicating] passage.